

WHAT IS CLAIMED IS:

1. A method for regulating the air temperature in a food cart within an aircraft galley system, the galley system including a galley air cooling unit having the food cart and a galley plenum therein, the plenum including a heat exchanger, a  
5 fan which blows air across the heat exchanger, into the food cart via an air supply duct coupling the plenum to the food cart and back into the plenum via an air return duct coupling the food cart to the plenum, an air supply temperature sensor for measuring the temperature of the air entering the food cart from the plenum, and an  
10 air return temperature sensor for measuring the temperature of the air entering the plenum from the food cart, the method utilizing a control system for performing the steps including:

regulating the return air temperature to a selected set point by controlling the amount of a liquid refrigerant flowing through the heat exchanger via a valve;

15 regulating the supply air temperature if the return air temperature sensor fails, regulating the supply air temperature including,

regulating the supply air temperature between a preset bottom threshold and a preset top threshold,

closing the valve completely if the supply air temperature falls below the preset bottom threshold,

20 opening the valve when the supply air temperature rises to the preset top threshold, and

resuming regulation of the supply air temperature between the preset bottom threshold and the preset top threshold; and

temporarily discontinuing regulation of the return air temperature if the supply air temperature drops below the preset bottom threshold, including,

closing the valve completely until the supply air temperature increases to the preset top threshold, and

5           resuming regulation of the return air temperature.

2.       The method of claim 1, wherein regulating the return air temperature to a selected set point includes regulating the return air temperature to a selected set point of about 4°C (39°F).

3.       The method of claim 1, wherein regulating the supply air temperature  
10       between a preset bottom and a preset top threshold includes regulating the supply air temperature between a preset bottom of about -1°C (31°F) and a preset top threshold of about 1°C (33°F).

4.       The method of claim 1, wherein the galley air cooling unit includes a  
15       galley air cooling unit switch for turning the galley air cooling unit on, a proximity switch which indicates the presence of a food cart within the galley air cooling unit, and a liquid refrigerant indicator which indicates whether the liquid refrigerant is sufficiently cool to regulate the air temperature in the galley air cooling unit, the method further including;

          regulating the valve and turning the fan on if:

20           the galley air cooling unit switch is ON,

          the proximity switch indicates that a food cart is within the galley air cooling unit, and

either the liquid refrigerant indicator indicates that the liquid refrigerant is sufficiently cool to regulate the air temperature in the galley air cooling unit or the liquid refrigerant is at least 2°C (4°F) below the selected set point.

5            5.        The method of claim 4, further including:

              closing the valve and turning the fan off if any of the following conditions are met:

                  the galley air cooling unit switch is turned OFF,

                  the proximity switch indicates that there is not a food cart within the  
10    galley air cooling unit, or

                  both the liquid refrigerant indicator indicates that the liquid refrigerant is not sufficiently cool to regulate the air temperature in the galley air cooling unit and the liquid refrigerant is at least 6°C (10°F) above the selected set point.

              6.        The method of claim 4, wherein turning the fan on includes randomly  
15    turning the fan on either immediately or after about a one second delay each time the fan is required to be turned on.

              7.        The method of claim 4, further including:

                  defrosting the galley air cooling unit following the expiration of a first preset duration of time when the air temperature in the galley air cooler is being regulated  
20    to the selected set point, the defrosting the galley air cooling unit including,

                  closing the valve,

leaving the valve closed for a second preset duration of time if the temperature of the heat exchanger fails to reach a preset upper temperature threshold, and

5 leaving the valve closed for an additional duration of time after the temperature of the heat exchanger reaches the preset upper temperature threshold if the preset upper temperature threshold is reached prior to the expiration of the preset duration of time; and

resuming regulation of the air temperature in the galley air cooling unit to the selected set point.

10 8. The method of claim 7, wherein:

defrosting the galley air cooling unit following the expiration of a first preset duration of time includes defrosting the galley air cooling unit following the expiration of about thirty minutes;

15 leaving the valve closed for a second preset duration of time if the temperature of the heat exchanger fails to reach a preset upper temperature threshold includes leaving the valve closed for about nine minutes if the temperature of the heat exchanger fails to reach about 2°C (36°F); and

leaving the valve closed for an additional duration of time includes leaving the valve closed for about five minutes.

20 9. The method of claim 7, wherein:

defrosting the galley air cooling unit following the expiration of a first preset duration of time includes defrosting the galley air cooling unit following the expiration of about forty minutes;

leaving the valve closed for a second preset duration of time if the temperature of the heat exchanger fails to reach a preset upper temperature threshold includes leaving the valve closed for about twelve minutes if the temperature of the heat exchanger fails to reach about 7°C (44°F); and

- 5            leaving the valve closed for an additional duration of time includes leaving the valve closed for about two minutes.

10.    The method of claim 7, wherein defrosting the galley air cooling unit further includes turning the fan off at intervals of about every three minutes for about twenty seconds during defrosting of the galley air cooling unit.

- 10            11.    The method of claim 7, further including ending defrosting if the galley air cooling switch is transitioned to OFF during defrosting of the galley air cooling unit.

12.    The method of claim 7, further including ending defrosting if the proximity switch indicates that there is not a food cart within the galley air cooling unit during defrosting of the galley air cooling unit.
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13.    The method of claim 1, wherein the galley air cooling unit includes a galley air cooling unit switch for turning the galley air cooling unit on, the method further including:

- turning the fan on when the galley air cooling unit switch is transitioned to ON;
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running the fan for a preset duration of time after the galley air cooling unit switch is transitioned to ON;

turning the fan off if the galley air cooling unit switch is transitioned to OFF prior to the expiration of the preset duration of time; and

opening the valve partially at the expiration of the preset duration of time if the galley air cooling unit switch remains in the ON position.

5           14.     The method of claim 13, wherein running the fan for a preset duration of time includes running the fan for about thirty seconds.

10           15.     The method of claim 1, wherein the valve is electronically controlled such that the valve opens further as the voltage level feeding the valve increases until the valve is fully open, the allowable voltage feeding the valve being regulated by pulse width modulation settings, the pulse width modulations having a control range, the method further including:

opening the valve at a maximum rate of about 10% per second of the pulse width modulation control range; and

15           closing the valve at a maximum rate of about 10% per second of the pulse width modulation control range.

16.     The method of claim 15, wherein:

opening the valve to a fully open condition includes applying about 90% of the allowable voltage to the valve; and

20           closing the valve to a fully closed condition includes applying about 20% of the allowable voltage to the valve.

17.     A method for regulating the air temperature in a food cart within an aircraft galley system, the galley system including a galley air cooling unit having the food cart and a galley plenum therein, the plenum including a heat exchanger, a

valve to control the flow of a liquid refrigerant through the heat exchanger, a fan which blows air across the heat exchanger, into the food cart via an air supply duct coupling the plenum to the food cart and back into the plenum via an air return duct coupling the food cart to the plenum, an air supply temperature sensor for

5 measuring the temperature of the air entering the food cart from the plenum, and an air return temperature sensor for measuring the temperature of the air entering the plenum from the food cart, the galley air cooling unit having a galley air cooling switch for turning the galley air cooling unit on, a proximity switch which indicates the presence of a food cart within the galley air cooling unit, and a liquid refrigerant

10 indicator which indicates whether the liquid refrigerant is sufficiently cool to regulate the air temperature in the galley air cooling unit, the method utilizing a control system for performing the steps including:

turning the fan on when the galley air cooling unit switch is transitioned to ON;

15 running the fan for a preset duration of time after the galley air cooling unit switch is transitioned to ON;

turning the fan off if the galley air cooling unit switch is transitioned to OFF prior to the expiration of the preset duration of time;

opening the valve partially at the expiration of the preset duration of time if

20 the galley air cooling unit switch remains in the ON position.

regulating the valve if,

the galley air cooling unit switch is ON,

the proximity switch indicates that a food cart is within the galley air cooling unit, and

either the liquid refrigerant indicator indicates that the liquid refrigerant is sufficiently cool to regulate the air temperature in the galley air cooling unit or the liquid refrigerant is at least 2°C (4°F) below the selected set point;

- 5 closing the valve and turning the fan off if any of the following conditions are met,

the galley air cooling unit switch is turned OFF,

the proximity switch indicates that there is not a food cart within the galley air cooling unit, or

- 10 both the liquid refrigerant indicator indicates that the liquid refrigerant is not sufficiently cool to regulate the air temperature in the galley air cooling unit and the liquid refrigerant is at least 6°C (10°F) above the selected set point;

regulating the return air temperature to a selected set point by controlling the amount of the liquid refrigerant flowing through the heat exchanger via the valve;

- 15 regulating the supply air temperature if the return air temperature sensor fails, regulating the supply air temperature including,

regulating the supply air temperature between a preset bottom threshold and a preset top threshold,

- 20 closing the valve completely if the supply air temperature falls below the preset bottom threshold,

opening the valve when the supply air temperature rises to the preset top threshold, and



resuming regulation of the supply air temperature between the preset bottom threshold and the preset top threshold; and

temporarily discontinuing regulation of the return air temperature if the supply air temperature drops below the preset bottom threshold, including,

- 5 closing the valve completely until the supply air temperature increases to the preset top threshold, and

resuming regulation of the return air temperature.